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HIGH SCHOOL AND UNIVERSITY MATRICULATION
EXAMINATIONS BOARD

DEPARTMENTAL EXAMINATIONS, 1969
AUGUST

CHEMISTRY 30X

Time — 2 hours.

DO NOT SPEND TOO MUCH TIME ON ANY ONE QUESTION.
READ THE PAPER CAREFULLY.

Total Possible Mark — 100.

Questions 1 to 50 are multiple questions, valued at 2 marks each.

Record answers on the answer sheet provided using an ordinary HB pencil.

This is an OPEN BOOK examination in which texts, references, and notes may be used.

Candidates are permitted to use slide rules and mathematical tables.

To ensure accuracy in the handling of your examination papers, the following sections on your ANSWER SHEET MUST BE COMPLETED.

SECTION A — Supply information as requested.

SECTION B — Labels will not be provided for the August examinations.
Therefore disregard the box re label.

Indicate your name, mailing address and birth date in the space provided.

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DO NOT FOLD EITHER THE ANSWER SHEET OR THE TEST BOOKLET.

Your presiding examiner will collect the answer sheet and booklet separately for transmission to the Department.

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Each question has a value of two marks and all are to be machine scored.

For each question choose the BEST answer and record it carefully on the ANSWER SHEET provided.

EXAMPLE:

One mole of H_2S gas contains

- A. 2 atoms of hydrogen
- B. 3 atoms
- C. 2 moles of hydrogen
- D. 1 gram of hydrogen

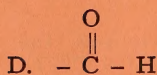
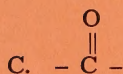
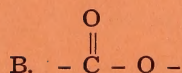
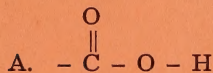
ANSWER SHEET

 A B C D E

DISREGARD COLUMN "E"
ON ANSWER SHEET.

Use an ORDINARY HB PENCIL to record your answers. Make sure your answer marks are heavy and black and that they do not extend beyond the guide lines. If you change your mind about an answer, be sure to erase your first mark completely. There must be only ONE answer marked for each question. Be sure there are no stray pencil marks on your answer sheet.

1. The functional group that identifies an organic acid is



2. Which of the following is a saturated hydrocarbon?

- A. C_5H_{12}
- B. C_2H_2
- C. C_6H_6
- D. C_2H_4

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(No marks given for work in this space)

3. In the titration of a sulfuric acid solution, 60 ml of 0.5 M NaOH solution were used to neutralize 75 ml of the acid. The molarity of the acid solution was
- 0.10 M
 - 0.20 M
 - 0.25 M
 - 0.40 M
4. Which of the following, in water solution, could be expected to form a precipitate when mixed with a solution of KCl?
- $(\text{NH}_4)_2\text{SO}_4$
 - $\text{Hg}_2(\text{NO}_3)_2$
 - CaS
 - $\text{Fe}(\text{NO}_3)_2$
5. Which of the following reactions is a fission reaction?
- $${}^7_3\text{Li} + {}^1_1\text{H} \longrightarrow {}^7_4\text{Be} + {}^1_0\text{n}$$
 - $$\text{Zn}^{+2} + 2\text{e}^- \longrightarrow \text{Zn}$$
 - $${}^{14}_7\text{N} + {}^1_0\text{n} \longrightarrow {}^{10}_4\text{B} + {}^5_3\text{Li}$$
 - $${}^{232}_{90}\text{Th} \longrightarrow {}^{232}_{91}\text{Pa} + {}^0_{-1}\text{e}$$
6. A positive oxidation state is found in all halogens except
- fluorine
 - chlorine
 - bromine
 - iodine

FOR ROUGH WORK

(No marks given for work in this space)

FOR ROUGH WORK

(No marks given for work in this space)

7. Which of the following would give NO evidence of a chemical change?
- A solution of sulfuric acid and a solution of potassium chromate, K_2CrO_4 are mixed.
 - NH_4Cl crystals are dissolved in water.
 - HCl is added to a saturated solution of NaCl.
 - Sodium nitrate solution and potassium chloride solution are mixed.
8. When oxygen is dissolving in water the energy is
- increasing and the randomness is decreasing
 - decreasing and the randomness is decreasing also
 - increasing and the randomness is increasing
 - decreasing and the randomness is increasing
9. Zinc powder reacts more readily with 6 M HCl than a zinc strip does because of a difference in
- concentration
 - activation energy
 - surface area
 - energy content
10. Concentrated sulfuric acid and water are mixed to produce a solution. Which of the following is NOT true?
- The acid should be added to the water.
 - The solution would be colorless if phenolphthalein were added to it.
 - Sulfuric acid has a lower heat of hydration.
 - Considerable heat is released when water and concentrated sulfuric acid are mixed.
11. Raising the temperature of a reaction system does NOT increase the
- activation energy
 - rate of reaction
 - rate of collisions
 - average velocity of the reacting particles
12. A voltaic cell consists of: $Ni_{(s)} / Ni^{+2} \parallel Cu^{+2} / Cu_{(s)}$
- The flow of current in the cell solutions consists of a movement of
- cations toward Ni electrode only
 - anions toward Ni electrode only
 - cations toward the Ni electrode and of anions toward the Cu electrode
 - anions toward the Ni electrode and cations toward the Cu electrode

FOR ROUGH WORK

(No marks given for work in this space)



In the above reaction, water is

- A. an electron acceptor
- B. an electron donor
- C. a proton acceptor
- D. a proton donor

14. A spontaneous reaction ALWAYS

- A. achieves equilibrium
- B. is endothermic
- C. has an energy content greater for the products than for the reactants
- D. is exothermic

15. The strongest oxidizing agent is

- A. Mn^{+2}
- B. Mn
- C. MnO_2
- D. MnO_4^-

16. When stearic acid reacts with glycerol to form stearin, the type of reaction is called

- A. saponification
- B. polymerization
- C. esterification
- D. hydrogenation

FOR ROUGH WORK

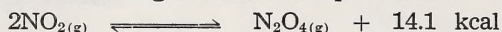
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17. In the reaction $2\text{SO}_3 + \text{heat} \rightleftharpoons 2\text{SO}_2 + \text{O}_2$ an increase in temperature will increase production of
- SO_3 only
 - SO_3 and O_2 only
 - SO_2 and O_2 only
 - SO_3 , SO_2 and O_2

18. When a few drops of 0.2 M potassium hydroxide is added to 15 ml of aluminum nitrate a white precipitate is formed. Which of the following represents the correct net ionic equation for the reaction?

- $\text{Al}^{3+}_{(\text{aq})} + 3\text{OH}^{-}_{(\text{aq})} \longrightarrow \text{Al}(\text{OH})_{3(\text{s})}$
- $\text{Al}^{3+}_{(\text{aq})} + 3\text{NO}_3^{-}_{(\text{aq})} + 3\text{K}^{+}_{(\text{aq})} + 3\text{OH}^{-}_{(\text{aq})} \longrightarrow \text{Al}(\text{OH})_{3(\text{s})} + 3\text{KNO}_{3(\text{s})}$
- $\text{Al}(\text{NO}_3)_{3(\text{aq})} + 3\text{KOH}_{(\text{aq})} \longrightarrow \text{Al}(\text{OH})_{3(\text{s})} + 3\text{KNO}_{3(\text{s})}$
- $3\text{K}^{+}_{(\text{aq})} + 3\text{NO}_3^{-}_{(\text{aq})} \longrightarrow 3\text{KNO}_{3(\text{s})}$

19. Consider the following reaction at equilibrium:



In order to reach equilibrium in a shorter interval of time which one of the following changes would be most appropriate?

- Decrease the pressure.
- Decrease the temperature.
- Decrease the concentration of $\text{NO}_{2(\text{g})}$.
- Add a catalyst.

FOR ROUGH WORK

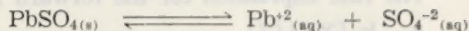
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Use the following information to answer questions 20 and 21.

K_{sp} values for PbSO₄

at 18° C = 1.06×10^{-8}

at 25° C = 1.3×10^{-8}

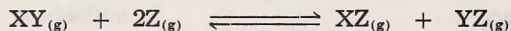


- 20.** The K_{sp} values for PbSO₄ show that
- the solubility of PbSO₄ decreases slightly as the temperature rises
 - at either 18° C or 25° C the equilibrium concentration of products would exceed the equilibrium concentration of reactants
 - the solubility of PbSO₄ increases slightly as the temperature rises
 - the randomness factor is more dominant than the energy factor in the dissolving of PbSO₄
- 21.** If 10 ml of 0.03 M Pb(NO₃)₂ solution is added to 10 ml of 0.001 M K₂SO₄ solution at 25° C, and the temperature is then lowered to 18° C, one would expect
- no precipitate to form at either temperature
 - a precipitate to form at 25° C followed by further precipitation as the temperature drops to 18° C
 - a precipitate to form at 25° C which disappears as the temperature drops to 18° C
 - no precipitate to form at 25° C but as the temperature drops to 18° C a precipitate forms
- 22.** Which of the following, when dissolved in water, will be the BEST conductor of an electric current?
- ammonia
 - hydrogen chloride
 - sugar
 - lead sulfide

FOR ROUGH WORK

(No marks given for work in this space)

23. Following is a reaction stated in general terms.



The rate expression for the forward reaction is

- A. $k [\text{XY}] [\text{Z}]$
- B. $k [\text{XY}] [2\text{Z}]$
- C. $k [\text{XY}] [\text{Z}]^2$
- D. $k [\text{XZ}] [\text{YZ}]$

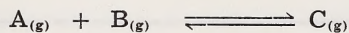
24. Which one of the following, in water solution at room temperature, is the weakest acid?

- A. H_2PO_4^-
- B. HNO_2
- C. H_2S
- D. HSO_3^-

25. Select the FALSE statement.

- A. Bromine exists as a liquid at room temperature and pressure
- B. The blue color of iodine in a starch solution is a sensitive test for iodine.
- C. Disproportionation is typical of the halogens.
- D. The fluoride ion, F^- , is easily oxidized.

26. Given the reaction



The equilibrium constant for the above reaction is 8. If the equilibrium concentration of $\text{C}_{(g)}$ is 1 mole per liter and of $\text{B}_{(g)}$ is 2 moles per liter the concentration of $\text{A}_{(g)}$ is

- A. 1 mole per liter
- B. $\frac{1}{2}$ mole per liter
- C. $\frac{1}{4}$ mole per liter
- D. $\frac{1}{8}$ mole per liter

FOR ROUGH WORK

(No marks given for work in this space)

27. The oxidation number for cobalt in potassium cobaltinitrite $K_3[Co(NO_2)_6]$ is
- +3
 - 0
 - +6
 - +9
28. In the system $CuS_{(s)} \longrightarrow C^{+2}_{(aq)} + S^{-2}_{(aq)}$ if the equilibrium concentration of Cu^{+2} is doubled, the equilibrium concentration of S^{-2} will
- be two times the original value
 - be one half the original value
 - be one quarter of the original value
 - not change
29. Suppose you have a test tube containing 100 ml of a Fe^{+2} ion solution. The concentration of the Fe^{+2} ion is 0.10 M. You add to this test tube 100 ml of a 0.20 M SO_4^{-2} ion solution. When these two solutions are mixed the concentration of the SO_4^{-2} ion will be
- 0.05 M
 - 0.10 M
 - 0.20 M
 - 0.30 M
30. The value for the product of ion concentrations for $FeSO_4$ in Question 29 is
- 5.0×10^{-3}
 - 5.0×10^{-2}
 - 2.0×10^{-2}
 - 1.0×10^{-1}

FOR ROUGH WORK

(No marks given for work in this space)



FOR ROUGH WORK

(No marks given for work in this space)

- an aromatic compound
- cyclohexane
- a member of the alkane family
- an unsaturated hydrocarbon

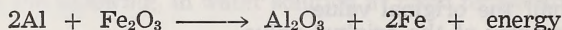
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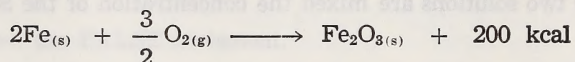
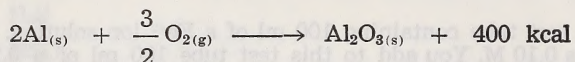
31. Experiments show that 1.59×10^{-2} moles of PbCl_2 may be dissolved in 1 liter of distilled water at which concentration it is saturated. The K_{sp} for PbCl_2 can be calculated to be:

A. 2.54×10^{-4}
 B. 5.06×10^{-4}
 C. 1.62×10^{-5}
 D. 4.04×10^{-6}

32. On the spot welding is often done using a reaction between powdered aluminum and ferric oxide. The equation for this "thermit" process is



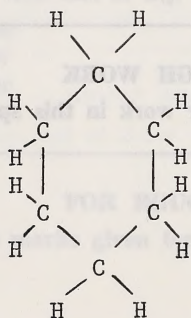
Given the following information:



Which of the following values represents the amount of heat generated for every 35 grams of iron released for welding?

A. 62.5 kcal
 B. 125 kcal
 C. 200 kcal
 D. 375 kcal

33.



The above structure represents

A. an aromatic compound
 B. cyclohexene
 C. a member of the alkane family
 D. an unsaturated hydrocarbon

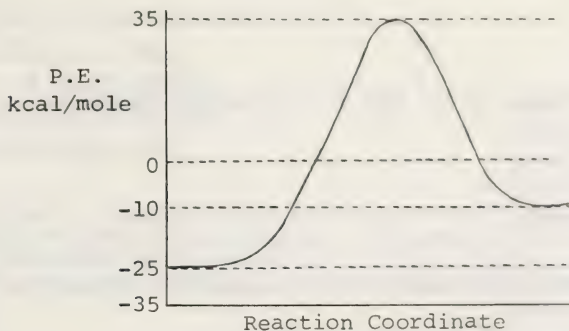
FOR ROUGH WORK

(No marks given for work in this space)

34. A gaseous compound is known to contain sulfur and fluorine in the ratio of one atom of sulfur to one atom of fluorine. If a mole of this gas weighs approximately 102 grams, what is the molecular formula of this compound?

A. SF
 B. S₂F₂
 C. S₃F₃
 D. S₄F₄

35.



The above diagram represents the general reaction



The activation energy for the forward reaction is

A. -25 kcal
 B. 0 kcal
 C. 35 kcal
 D. 60 kcal

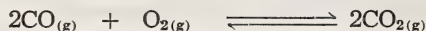
36. ΔH for the forward reaction diagrammed in Question 35 is

A. -15 kcal
 B. +15 kcal
 C. +20 kcal
 D. +35 kcal

FOR ROUGH WORK

(No marks given for work in this space)

- 37.** Carbon monoxide reacts with oxygen gas to produce carbon dioxide as shown by the following equation:



Suppose 4 moles of $\text{CO}_{(g)}$ and 2 moles of $\text{O}_{2(g)}$ are placed in an empty vessel and the above reaction takes place. After equilibrium has been reached the mixture is analyzed and 0.5 moles of $\text{O}_{2(g)}$ are found to be present. The number of moles of $\text{CO}_{2(g)}$ that should also be present at equilibrium is

- A. 1.5
B. 2.0
C. 3.0
D. 4.0
- 38.** The concentration of the OH^- in a 10 M HCl solution is
- A. 1×10^{-12} M
B. 1×10^{-13} M
C. 1×10^{-14} M
D. 1×10^{-15} M
- 39.** In the electrolysis of concentrated hydrochloric acid which one of the following statements is correct?
- A. Hydronium ions are reduced at the anode.
B. Hydronium ions are oxidized at the cathode.
C. Chloride ions are oxidized at the anode.
D. Chloride ions are reduced at the cathode.
- 40.** An electrolytic cell has a copper electrode immersed in a solution of cupric nitrate and a silver electrode immersed in a solution of silver nitrate. If 1.25 moles of copper were plated out during a given interval of time, the number of moles of silver that would be plated out in half that amount of time, assuming the current is the same in both cases, would be
- A. 2.50 moles
B. 2.00 moles
C. 1.25 moles
D. none of the above

FOR ROUGH WORK

(No marks given for work in this space)

41. In the electrolytic cell mentioned in Question 40, how many grams of copper would be plated if a current of 5.0 amperes flows for one minute? (1 ampere is equal to 1.0×10^{-5} mole of electrons per second.)
- A. 1.9×10^{-2} g
B. 9.5×10^{-2} g
C. 9.5×10^{-1} g
D. 1.9×10^{-1} g
42. Which of the following is an amide?
- A. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CONH}_2$
B. $\text{NH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$
C. $\text{COOHCH}_2\text{CH}_2\text{CHNH}_2\text{COOH}$
D. $\text{NH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
43. 5.0×10^{-1} kcal is required to raise the temperature of a calorimeter and its contents by one degree centigrade. When 3.9 grams of benzene, C_6H_6 , were burned as the heat source the temperature of the calorimeter and its contents was raised by 10°C . The molar heat of combustion of benzene from the above information is
- A. 1.3 kcal
B. 5.0 kcal
C. 10.0 kcal
D. 100 kcal
44. Volume of 1.4 kg of 18.0 M sulfuric acid is
- A. 25.2 liters
B. 3.90 liters
C. 1.26 liters
D. 0.795 liter
-

FOR ROUGH WORK

(No marks given for work in this space)



39780803 CURR HIST

45. For the reaction $\text{N}_{2(g)} + 3\text{H}_{2(g)} \longrightarrow 2\text{NH}_{3(g)}$
occurring at 500°C the following data was obtained



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EXPERIMENT	INITIAL CONCENTRATIONS		RELATIVE INITIAL RATE
	N_2	H_2	
I.	$1.00 \times 10^{-3} \text{ M}$	$1.00 \times 10^{-3} \text{ M}$	1
II.	$1.00 \times 10^{-3} \text{ M}$	$2.00 \times 10^{-3} \text{ M}$	4
III.	$1.00 \times 10^{-3} \text{ M}$	$3.00 \times 10^{-3} \text{ M}$	9
IV.	$2.00 \times 10^{-3} \text{ M}$	$2.00 \times 10^{-3} \text{ M}$	4
V.	$4.00 \times 10^{-3} \text{ M}$	$2.00 \times 10^{-3} \text{ M}$	4
VI.	$6.00 \times 10^{-3} \text{ M}$	$2.00 \times 10^{-3} \text{ M}$	4

The rate expression for this reaction on the basis of the above data only is

- A. $R = k[\text{H}_2]^1[\text{N}_2]^0$
B. $R = k[\text{H}_2]^0[\text{N}_2]^1$
C. $R = k[\text{H}_2]^2[\text{N}_2]^0$
D. $R = k[\text{H}_2]^2[\text{N}_2]^1$

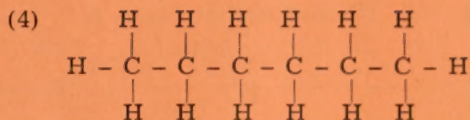
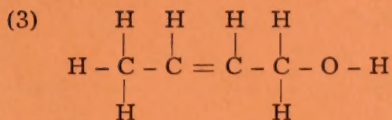
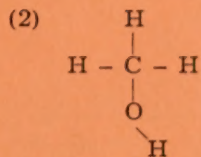
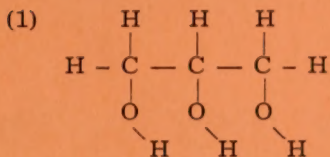
FOR ROUGH WORK

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LB 3054 C2 D419 1969a chem.30X
Departmental examinations,
[grade 12] 1969, August. -

39780803 CURR HIST

Questions 46, 47 and 48 relate to four compounds with the following structural formulae:



- 46.** The compound with the highest boiling point is
- 1
 - 2
 - 3
 - 4
- 47.** The compound which will most readily reduce an MnO^- solution is
- 1
 - 2
 - 3
 - 4
- 48.** The compound which will be the least soluble in water is
- 1
 - 2
 - 3
 - 4

FOR ROUGH WORK

(No marks given for work in this space)

49. The pH of a 2.5×10^{-1} M acid solution ($K_a = 4 \times 10^{-10}$)

- A. 1
- B. 2
- C. 5
- D. 9

50. Which of the following is CORRECT?

- A. Cu displaces both Zn^{+2} and Fe^{+2}
- B. Zn displaces Cu^{+2} but not Fe^{+2}
- C. Fe displaces Zn^{+2} but not Cu^{+2}
- D. Cu displaces neither Zn^{+2} nor Fe^{+2}

FOR ROUGH WORK

(No marks given for work in this space)